STRATEGY RESEARCH PROJECT

REVOLUTION IN MILITARY AFFAIRS: ITS IMPACT ON OPERATIONAL FIRES AND THE FUTURE BATTLEFIELD

BY

LIEUTENANT COLONEL MICHAEL P. SULLIVAN
United States Air Force

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U.S. ARMY WAR COLLEGE, CARLISLE BARRACKS, PA 17013-5050

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BY

Lieutenant Colonel Michael P. Sullivan
United States Air Force

Colonel Jack W. Ellertson, USA
Project Advisor

U.S. Army War College
Carlisle Barracks, Pennsylvania 17013

ABSTRACT

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The revolution in military affairs (RMA)is about change. The U.S. is in the midst of a RMA: a revolution in information, sensing and precision strike technologies. The RMA will allow friendly forces to locate enemy forces quickly and precisely, whether those enemies are agrarian, industrial, or an information age force. The key to the future battlefield is the operational commander's capability to locate, identify, outmaneuver and outshoot enemy forces. The RMA underway today is bringing unprecedented depth, transparency and lethality to the battlefield. The purpose of this paper is to analyze operational fire, sensor, and C4I systems and show that the result of this increased capability is the creation of a "fatal visibility" on the future battlefield.

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INTRODUCTION

Technology impacts all people in all walks of life. No one is immune from its effects. From the time you wake up in the morning until you go to bed at night, technology is a constant force in daily life. So much so, that it almost has a life of its own.

Technology has not only improved our personal lives, but has also had a major impact on military hardware and capabilities. Today, the soldier on the ground can pinpoint his location by using a hand-held receiver which is linked to a satellite. In the not too distant future, the land warrior will be a high-tech sensing device. The soldier's helmet will have a TV camera, an infrared night vision system, and a computer display that can project maps or battlefield graphics. To improve his chances of survival, the soldier's battle dress will be able to protect him by detecting chemical and biological agents and mines. It will incorporate a cooling system within the body armor which will reduce body temperature enough to make the soldier less visible to the enemy's infrared sensors. Improvements in the soldier's offensive capability will include a lightweight and very destructive hand-held missile launcher with a computerized targeting system.[1]

According to futurists Alvin and Heidi Toffler, the revolution in technological development has moved the U.S. military out of the second wave era, the industrial age, into the third wave era, the information age. The Toffler's theory is that warfare has gone through three major revolutions based on

societal structure. First wave war was based on cyclical patterns of war driven by agricultural needs. Second wave war resulted from the massing of society and armies as a result of the industrial revolution. Third wave war is now emerging as information based war.[2]

We are in the midst of a revolution in military affairs: a revolution in information, sensing and precision strike technologies. Technological advancements are permitting modern military forces to conduct operations with an unprecedented degree of precision. In addition, these advancements provide commanders with the capability of using computer screens to locate their forces, watch battles unfold and issue timely corrections.[3]

The key to the future battlefield is the operational commander's capability to locate, identify, outmaneuver and outshoot enemy forces. The revolution in military affairs underway today is bringing unprecedented depth, transparency and lethality to the battlefield. One by-product of the RMA is an increased capability in operational fires, via new sensor systems, and C4I systems. The purpose of this paper is to analyze these systems and show that the result of this increased capability is the creation of a "fatal visibility" on the future battlefield.

REVOLUTION IN MILITARY AFFAIRS

The revolution in military affairs (RMA) is about change. Currently the RMA is characterized by several types of change:

information warfare; precise, stand-off weapons; and improved command, control, and intelligence systems.

The core of the RMA, the foundation which holds it in place is information. Information has and will continue to be the cornerstone of warfare. This is more true today than ever before. Knowledge of the enemy's position provides the basis for military action. In order for precision-guided munitions to be effective, the precise location of enemy targets is necessary. In addition, the rapid exchange of information about the status of the battle and reliable, real-time command and control are vital to success.[4] Information dominance is imperative. The commander must be able to obtain the necessary information for friendly forces while at the same time denying it to the enemy.[5]

Past experience has shown that accuracy diminished with distance. Technology, however, has been able to increase the distance at which fires could be accurate. Some familiar examples include the invention of recoil mechanisms for rifled artillery, the development of strategic bombing and close air support and the invention of guided missiles. Distance still has an effect on accuracy, but technological developments in weaponry and the ability to locate and pinpoint the enemy is making precise, stand-off strikes possible.[6]

Military analysts predict that technology will not only improve information gathering systems and make dumb weapons smart, but will also have a dramatic improvement on command, control and intelligence systems. This improvement will result

in near-simultaneous destruction of enemy forces and their war-making capability, as well as provide up-to-date, near complete friendly and enemy information, making situational awareness available to all forces.[7]

To summarize, the RMA will allow friendly forces to locate enemy forces quickly and precisely, whether those enemies are agrarian/first wave war lords, industrial/second wave armies, or an information age/third wave force. In addition, the RMA will allow friendly forces to know where their forces are, while at the same time denying that kind of information to the enemy. And finally, information about enemy units and friendly formations will be distributed among all committed forces - land, sea, and air to create a common perception of the battlefield. This will allow friendly forces to observe, decide, and act faster and more precisely than their enemies.[8]

OPERATIONAL FIRES

Definition: FM 100-7, Decisive Force: The Army in Theater Operations defines operational fires as "a commander's application of nonlethal and lethal firepower to achieve a decisive impact on the conduct of a campaign or major operation." Operational fires are a separate element of the commander's concept of operations but must be integrated and synchronized with the commander's concept of maneuver.

Operational fires and maneuver may occur simultaneously but may not necessarily have the same objectives. Operational maneuver is not dependent on operational fires, but can be

affected by it and can exploit opportunities created or developed by operational fires. Operational fires are not fire support but are furnished by assets other than those required for the routine support of tactical maneuver.[9] Finally, operational fires include targeting and attacking land and sea targets whose destruction or neutralization would have a significant impact on a campaign or major operation.

Operational fires are joint, can be multinational, and are a vital component of an operational plan.[10] In the past, the Air Force was the primary supplier of operational fires. However, advances in technology have increased the range and accuracy of rocket and missile systems. Combined with attack helicopter operations, this provides the Army commander with his own organic operational fires capability. The ability of each service to engage targets at operational depths demonstrates the joint and combined nature of operational fires.[11]

Objectives: Operational fires assist the land commander in accomplishing his mission and protecting his forces. These fires possess the capability of achieving operational objectives by extending the battlefield in both space and time. Targets critical to the success of friendly operations exist throughout the depth of the battlefield. Current systems and emerging technologies are providing the capability of detecting and attacking these targets at greater distances and faster response times. Operational fires can delay, disrupt, divert or destroy the enemy's ability to maintain offensive momentum on the

battlefield. This capability makes it possible for the commander to dictate the terms for close battle.[12]

Operational fires are more than deep fires. They achieve tactical objectives by limiting the enemy capabilities, which helps the commander seize and retain the initiative, alter the tempo of operations, and set the conditions for decisive close combat.[13] Operational fires deny the enemy a place to hide and time to rest limiting his freedom of action.

Tasks: Operational fires assist maneuver in depth by suppressing the enemy's deep strike systems, disrupting his operational maneuver, and creating gaps in his defenses. Interdiction and maneuver are inseparable operations; the synergy acquired by integrating and synchronizing interdiction and maneuver can be devastating to enemy forces. If the enemy elects to counter friendly maneuver, he is vulnerable to attack by interdiction forces. However, if he elects to reduce his losses to interdiction, then he is unlikely to be able to counter friendly maneuver.[14]

Another major task of operational fires is isolating the battlefield. This is accomplished by interdicting the enemies military potential before it can be used effectively against friendly forces. Using the concept of follow-on forces attack (FOFA), friendly forces can defend themselves by targeting enemy formations deep in their own territory. FOFA concentrates its interdiction effort on uncommitted enemy forces, which could influence the close battle if not attacked. This action

restricts the enemy's freedom of movement, information flow and influence the enemy's tempo by diverting, delaying and disrupting his forces.[15]

Joint Force Commanders (JFC) can take the FOFA concept and elevate it to another level through the technique of Joint Precision Interdiction (JPI), which attempts to establish an advantageous mobility differential over the enemy.[16] The major aspects of JPI: locating the enemy deep, blinding his sensors, and adversely affecting his mobility, attempt to protect the JFC's freedom of maneuver while denying the same to the enemy.[17]

Before Desert Storm, air assets were the primary means to conduct FOFA. The technological developments in the 1980s provided the capability for long-range interdiction by ground and sea launched systems as evidenced during the Gulf War. The commander can now bring all the services assets to bear against the enemy. The following are just a few of the precision-guided munitions/operational fires assets which are a part of JPI and are available to the joint force commander:

Tomahawk Land Attack Missile (TLAM) - is a long-range cruise missile for both surface and submarine launch against both surface-ship and land targets. It is capable of carrying conventional and nuclear warheads. The TLAM has an inertial guidance system and terrain contour matching computer, it flies at sub-sonic speeds, can range between 470-2,500 kilometers (depending on the warhead), and its average accuracy is between 33-100 feet.[18]

Surface Land Attack Missile (SLAM) - is an imaging infrared seeker, man-in-the-loop-terminally guided missile that is derivative of the AGM-84A Harpoon antiship missile. It is launched from aircraft and surface ships, and is capable of two modes of attack: preplanned missions against high-value fixed or relocatable land targets and target of opportunity missions against ships at sea. The SLAM cruises at high sub-sonic speed, has a range of 60+ kilometers and an accuracy of 52 feet.[19]

Joint Direct Attack Munition (JDAM) - adds an INS/GPS guidance kit to a 2,000-lb general-purpose Mk-84, the 2,000-lb BLU-109 penetrator bomb, and the general-purpose 1,000-lb Mk-83. This weapon will receive target information while still aboard the launch aircraft, but after launch the inertial guidance kit will take over and guide the weapon to the target.[20]

Joint Standoff Weapon (JSOW) - a USN/USAF low cost, highly lethal glide weapon with a standoff capability (max range 46 miles), guided by a tightly coupled inertial navigation system (INS)which is tied into the Global Positioning System (GPS).[21]

Conventional Air Launched Cruise Missile - a conventionally armed air-launched cruise missile. Flies at sub-sonic speeds and is programmed for precision attack on surface targets. Range of this weapon is approximately 1555 miles.[22]

Have Nap - a medium range, standoff missile which will provide long-range bombers (B-1, B-2, and B-52) with a conventional precision strike capability. Range of this weapon is 50 miles.[23]

High-Speed Anti-Radiation Missile (HARM) - a highly successful suppression of enemy air defense (SEAD) missile. The HARM can delay acquisition of target until after launch and can attack a broad spectrum of hostile radars. The high-explosive warhead is prefragmented into thousands of small steel cubes designed specifically to damage radar antenna and other fragile equipment.[24]

AGM-130 - a rocket-powered air-launched glide bomb fitted with a guidance system to give the weapon pin-point accuracy from low or medium altitudes over short standoff ranges.[25]

ATACMS/BAT - Army tactical missile system can engage deep, as well as cross-corps targets and provides deep near-real-time engagement capability. BAT is a brilliant antiarmor submunition which is fired by an ATACMS and uses acoustic and infrared sensors to detect, target and attack a formation of vehicles.[26]

The precision-guided systems described above are just a small example of assets available to the JFC and his air, land and sea component commanders in their quest to deny the enemy the ability to mass, move, communicate and sustain. However, in order for these weapons to be effective the commander must see enemy movement deep, identify priority targets and attack selected moving targets in near-real-time.[27] Intelligence, surveillance and reconnaissance (ISR) systems are the sensing and reporting technologies which provide the joint force commander with his vision of the battlefield and enhance his battlespace awareness.

Intelligence, Surveillance and Reconnaissance

During the summer of 1982, the Israelis and Syrians fought a short war. Most of the fighting took place during a two day period of 9-11 June. The battlefield was approximately 30 miles wide and 25 miles deep. It included the Bekaa valley and its surrounding mountains and hills. What makes the battles fought in this valley so interesting is the highly effective use, by the Israelis, of sophisticated advanced weapon systems and innovative tactics.[28]

The Israeli Air Force's campaign began with a surprise attack on the Syrian surface-to-air missile complex in the Bekaa Valley. Soon after, there was an air battle between Israeli and Syrian fighters; the largest air battle since WWII. The battle began with the use of remotely piloted vehicles (RPVs). The Israelis sent these RPVs into the airspace above the Bekaa Valley and the Syrians thinking these RPVs were Israeli F-4s and F-16s attacked with their surface-to-air missiles. When the radars came on, the Israelis flying behind the RPVs in manned aircraft, launched anti-radiation missiles against these radars. The result was devastating for the Syrians. They lost an entire air defense system, which included 20 surface-to-air missile batteries and more than 85 fighter aircraft. Israel owned the skies, and the Syrian ground forces were defenseless against an Israeli air attack. In addition to using the relatively inexpensive RPVs as decoys, the Israelis also mounted miniature television cameras on them. The camera fitted RPVs would circle

the battlefield and provide the Israeli commander, sitting in his ground-based command post, with continuous television cover of the battlefield.[29]

Gathering information about the enemy in a timely manner has always been a high priority of military operations. Good intelligence is essential for success of military operations. If a conflict should begin, reconnaissance can determine the capabilities of enemy forces, their size and location, and can track them to determine which direction they are moving.

Traditional methods of collecting intelligence, such as human intelligence and photographs taken from aircraft, are changing rapidly. In WWII, when an aircraft photographed an enemy force, the film had to be developed, analyzed and then the learned information was forwarded to the military commander. By the time the commander received the information, it was dated and the enemy would have probably moved to a new location. Today, satellites and high-tech aircraft are used for reconnaissance and intelligence gathering, however, the commander receiving this information is getting it in near-real time.

Some of the aircraft used in reconnaissance are the U-2 high-altitude reconnaissance aircraft, the E-3 airborne warning and control system (AWACS), and the E-8 Joint Surveillance and Target Attack Radar System (JSTARS). The U-2 is used for high-altitude reconnaissance: sixty thousand feet and above. The E-3 is designed to provide a mobile, flexible, survivable, and jam-resistant surveillance and command, control, and communications

system capable of all-weather, long-range, high or low-level surveillance of all air vehicles, manned or unmanned. This system can see almost anything flying for hundreds of miles and direct friendly aircraft for intercepts. The newest reconnaissance/intelligence gathering system is the E-8 JSTARS aircraft. What AWACS does for the air battle, JSTARS does for the ground battle. It was developed to undertake ground surveillance, targeting, and battle management missions. In December 1990, two JSTARS test aircraft deployed to Saudi Arabia to take part in Desert Storm. Both test aircraft flew 54 combat missions, supported 100 percent of mission tasking, and had a mission capable rate of 84.5 percent.[30] The aircraft identified target assembly areas, POL storage sites, SCUD launchers, tanks and convoys. When used with F-15s, F-16s, and F-111s, JSTARS effectively denied the enemy his night sanctuary. The JSTARS systems relayed near-real-time data on everything from the movement of mobile SCUD missile launchers to the location of concertina wire barriers and traffic on previously undetected roads. According to Lieutenant General Fornel, the commander of Electronic Systems Division, the JSTARS gave commanders a "real-time, God's eye view of the battle."[31]

In addition, Air Force Chief of Staff, General McPeak stated:

> "probably the most effective thing we did was to put F-15Es in airborne CAPS right overhead of these SCUD launch boxes, and then use JSTARS . . . When we found one that looked suspicious, then the JSTARS aircraft were able to divert the airborne CAPS and perform on the spot, ad lib attacks."[32]

JSTARS covered the entire Kuwaiti theater of operations in one orbit. During one 14-hour mission, each aircraft was able to feed target information to ground force corps commanders and the Central Air Force. The aircraft directed by JSTARS had a 90 percent success rate in finding targets on the first pass, and in one incident A-10s and an AC-130, directed by JSTARS, destroyed 58 of 61 vehicles in a single convoy.[33]

Because of its success in Desert Storm, the role of JSTARS will expand to include bomb damage assessment, suppression of enemy air defense, and theater missile defense.[34] JSTARS has proven in combat that it can be the "eyes" of the commander and allow him to see deep or over extended ranges laterally to expose enemy massing or maneuvering in near-real-time. This near-real-time capability will give the commander a visibility over the battlefield which will allow him to precisely target an enemy force, thereby creating a "fatal visibility" over the battlefield.[35]

COMMAND, CONTROL, COMMUNICATIONS, and COMPUTERS

> "What the Warrior needs: a fuzed, real time, true representation of the battlespace - and ability to order, respond and coordinate horizontally and vertically to the degree necessary to prosecute his mission in that battlespace."
>
> The C4I for the Warrior vision[36]

When the enemy is located and identified, decisions must be made as to how to deal with him. For example, what weapon to use and who should be the shooter. Command, control, communications and computers (C4) is the subsystem that converts the information

from the sensors into a deeper knowledge and understanding of the battlespace.[37]

The fundamental objective of C4 systems is to provide the commander with the critical and relevant information he requires to seize an opportunity and achieve his objective, battlespace dominance. Improvements in digitization, band width expansion, direct broadcasting, and computer processing enables C4 systems to handle the large amounts of data provided by the sensors. These technological developments will enable C4 systems to analyze important target information and transfer the information to the weapons/forces best suited to successfully engage the targets.

The high-tech sensors linked with current and emerging C4 systems provide the commander a previously unknown high degree of situational awareness. When combined with precise joint operational fires, this situational awareness allows a commander to synchronize combat power against the enemy, with a high degree of confidence, thus improving the opportunity for success on the battlefield.

FUTURE BATTLEFIELD

> "On the battlefield of the future enemy forces will be located, tracked and targeted almost instantaneously through the use of data-links, computer-assisted intelligence evaluation and automated fire control. With first-round kill probabilities approaching certainty, and with surveillance devices that can continuously track the enemy, the need for large forces to fix the opposition physically will be less important . . . I see battlefields that are under 24-hour real or near-real-time surveillance of all types. I see battlefields on which we can destroy anything we locate through instant communications and almost instantaneous application of highly lethal firepower."
>
> General William C. Westmoreland
> Chief of Staff, USA
> Speech to AUSA, 14 October 1969[38]

General Westmoreland's vision is quickly becoming a reality. Operation Desert Storm revealed that advanced technology combined with a well-trained fighting force and competent leadership can result in overwhelming victory on the battlefield.

The battlefield of the future will likely be much more complicated than those of the past. The integration of sensors, C4I and precise operational fires is introducing a level of precision to the overall force which until now has not been possible. The 21st century will see the systems of land forces integrated with air, sea and space forces which will result in improved precision at the point of battle.[39]

The developing high-tech battlefield will be dominated by precision weaponry, information support (reconnaissance and C3) and electronic warfare, all three integrating with synergistic effect which will change the nature of warfare. The dominant aspects of the future battlefield will be battle command, battle

space and depth and simultaneous attack.

Battle Command: Battle command is the exercise of authority and direction by a commander to accomplish operational objectives. The commander's vision and his stated intent guide the organization toward accomplishing the mission. Battle command must integrate and synchronize continuous operations to enable, enhance and protect the commander's decision cycle and mission execution while providing a common picture of the battlefield.[40]

The mechanism which will provide the common picture of the battlefield to all levels of command is digitization of the battlefield. Digitization is the process of integrating information systems across the battle using the power of the computer microprocessor and digital electronics. Coupled with satellite communications, digitization redefines the depth and breadth of the battlefield. In digitizing battlefield systems, a network links weapon systems, aerial platforms, surveillance, and communication systems, allowing the exchange of vast amounts of information. This process provides the commander, the shooter and supporter the ability to maintain a clear and accurate vision of the battlespace necessary to support planning and execution. In other words, digitization allows the warfighter to communicate vital battlefield information instantly, rather than through slow voice radio or even slower liaison efforts.[41]

Battlefield digitization provides situational awareness not only for the shooter but the commander as well. With situational

awareness comes the advantage of real-time synchronization: a force multiplier. When an enemy formation is located, the combination of instantaneous communication, grid accuracy and "smart" munitions will result in the rapid destruction of the enemy formation. The common picture of the battlefield, in near-real time, allows a commander to move his forces quickly, mass them at the critical place on the battlefield and at the decisive time. This near-real time capability helps a commander to impose "fatal visibility" over the battlefield which he can use to direct his forces to strike the enemy. The commander who possesses the clearest picture of the battlefield will more than likely succeed in combat. Digitization of battle command is one of the tools used to achieve dominance on the battlefield.

Battle Space: A joint concept, battle space, is closely associated with the components of battle command. Battle space involves the ability to visualize the area of operations and how forces interact. It includes the breadth, depth, and height in which the commander positions and moves assets over time.

Simply, battle space is the commander's vision of the battlefield and how all warfighting functions and activities can best interact to achieve overwhelming and decisive results. Commanders use the concept of battle space to help determine how the terrain and all available combat power can be used to dominate the enemy and protect the force. A commander who understands his battle space is able to synchronize combat power against the enemy and keep the opposing commander from

capitalizing and extending his own battle space.[42]

Depth and Simultaneous Attack: Depth and simultaneous attack will enable the commander to directly influence the enemy throughout the width, height and depth of his battle space to shock, then quickly defeat the enemy.

The means for depth and simultaneous attack vary. These means include joint air, ground maneuver units, joint precision fires, and information operations. Depth and simultaneous attack is a key characteristic of future operations. The goal is to overload the enemy's ability to cope by overwhelming him with a number of actions throughout the depth of the battlefield.[43]

Long range battle will become the dominant and independent form of combat in future war. Forces will employ electronic warfare, fixed and rotary wing aviation, long range artillery, and cruise/ballistic missiles, to engage the enemy throughout the depth of their deployment very quickly after their location is fixed by air and space-based reconnaissance assets.[44]
The effect of high-tech system integration on the battlefield of the future will be characterized by fewer forces maneuvering very quickly and dispersing over the breadth and depth of the battlefield. These smaller forces, will possess the ability to deliver a high volume of precisely aimed fires with a high first round hit probability. With the lethality of precise operational fires approaching the combat potential of tactical nuclear weapons, these forces will need to incorporate an operational maneuver cycle of concentrate-attack-disperse.[45]

For this cycle to be successful two things must happen. First, friendly forces must be able to see the enemy and deny him the ability to locate forces. Second, once the enemy is located, friendly forces must track and then attack and destroy him.

The combined effects of direct sensor-to-shooter linkage, real-time situational awareness, precise knowledge of the enemy, digitization and computer processing provides the commander with the advantage to operate within the opponent's decision cycle.

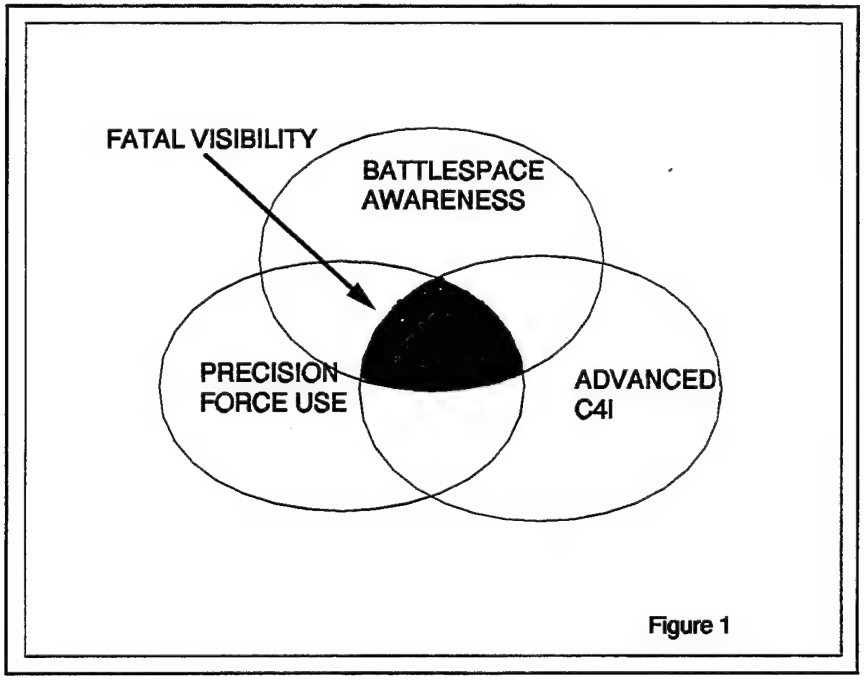

Figure 1

The shaded area in Figure 1 depicts the point where precision force, C4I and battlespace awareness merge to create dominant battlespace awareness and is also the point where "fatal visibility" is created over the battlefield.[46]

CONCLUSION

The nature of war will still consist of fear, fog, danger, uncertainty, deception and friction. On the battlefield of the future, these conditions, to a degree, will have an impact on the commander's situational awareness and effect his decision making. The future battlefield will challenge the commanders to make decisions quicker and execute those decisions over greater distances and in decreasing time. They will be required to direct fire and maneuver under more diverse conditions while maintaining cohesion among more dispersed units.

The future of war, especially the ability of the United States to anticipate and wage it, will be shaped and influenced by how we assess and adopt the technologies previously discussed. The information age armed force will be able to locate enemy forces quickly and precisely, whether those enemies are agrarian war lords, industrial armies, or an information age peer. Information age forces will know precisely where friendly forces are located, and deny this kind of information to the enemy. In addition, information about enemy units and friendly formations will be distributed among all committed forces, of every service to create a common perception of the battlefield. When coupled with the ability to conduct continuous operations, this shared situational awareness will allow information age forces to observe, decide, and act faster, more correctly and more precisely than their enemies.[47] In other words, taking advantage of the "fatal visibility" created on the battlefield will shape the future of war.

ENDNOTES

1. Dan Cordtz, "War in the 21st Century: The Digitized Battlefield," Financial World (August 29, 1995): 48.

2. Alvin and Heidi Toffler, War and Anti-War, (Boston: Little, Brown and Co., 1993), 33-43.

3. Michael J. Mazarr, "The Revolution in Military Affairs: A Framework for Defense Planning," (Carlisle Barracks, PA: Strategic Studies Institute, 1994), 2-3.

4. Ibid., 9.

5. Michael J. Mazarr, "The Military Technical Revolution," (Washington, D.C.: Center for Strategic and International Studies, 1993), 20.

6. Steven Metz and James Kievit, "Strategy and the Revolution in Military Affairs: From Theory to Policy," (Carlisle Barracks, PA: Strategic Studies Institute, 1995), 4.

7. Gordon R. Sullivan, General, USA and Lt Col James M. Dubik, "War in the Information Age," (Carlisle Barracks, PA: Strategic Studies Institute, 1994), 13-14.

8. Ibid., 14.

9. Department of the Army, Decisive Force: The Army in Theater Operations, Field Manual (FM) 100-7 (Washington: U.S. Department of the Army, 31 May 1995), 5-3.

10. Ibid

11. Ibid., 5-5.

12. Ibid., 5-7.

13. Ibid.

14. U.S. Department of Defense, Doctrine for Joint Operations, Joint Pub 3-0 (Washington: U.S. Department of Defense, 1 February 1995), IV-13-14.

15. Jack W. Ellertson, LTC, USA, and Alan K. Huffman, Lt Col, USAF, "Joint Precision Interdiction in the Post-CFE Environment," Military Review, (July 1991): 47.

16. U.S. Department of Defense, Doctrine for Joint Operations, IV-16.

17. Ibid.

18. Timothy R. Laur, Colonel and Steven L. Llanso, Encyclopedia of Modern U.S. Military Weapons, (New York: Berkley Books, 1995), 283-284.

19. Ibid., 280-281.

20. "USAF Almanac 1995", Air Force Magazine (May 1995): 146-148.

21. Ibid.

22. Ibid.

23. Ibid.

24. Laur and Llanso, 257.

25. "USAF Almanac 1995", 146-148.

26. Laur and Llanso, 276-277.

27. Ellertson and Huffman, 48.

28. Robert E. Harkavy and Stephanie G. Neuman, Military Lessons of the 1982 Israel-Syria Conflict, (Lexington, Massachusetts, Lexington Books, 1985), 261.

29. Frank Barnaby, The Automated Battlefield, (New York: The Free Press, 1986), 19.

30. Charles D. Lloyd, Joint Stars: Concept to Desert Storm Deployment, 25-27.

31. Ibid.

32. Ibid.

33. Ibid.

34. USAF Almanac 1995, 146-148.

35. Ellertson and Huffman, 49.

36. Joint Chiefs of Staff, C4I for the Warrior (Washington: J6 the Joint Staff, 12 June 1992), 1.

37. William A. Owens, Admiral, USN, "The Emerging System of Systems," Military Review, (May-June 1995): 17.

38. Barnaby, 1.

39. Gordon R. Sullivan, General, USA and Lt Col James M. Dubik, "Land Warfare in the 21st Century," (Carlisle Barracks, PA: Strategic Studies Institute, 1994), 16.

40. Department of the Army, Decisive Force: The Army in Theater Operations, Field Manual (FM) 100-7 (Washington: U.S. Department of the Army, 31 May 1995), 5-15.

41. Joseph E. Oder, Brig Gen, USA, "Digitizing the Battlefield: The Army's First Step to Force XXI," Army (May 1994): 38.

42. Department of the Army, Operations, Field Manual (FM) 100-5 (Washington: U.S. Department of the Army, June 1993), 6-13.

43. Department of the Army, Force XXI Operations: A Concept for the Evolution of Full-Dimensional Operations for the Strategic Army of the Early Twenty-First Century, TRADOC Pamphlet 525-5 (Fort Monroe, VA: U.S. Department of the Army, August 1994), 3-3 to 3-11.

44. Bruce W. Bennett, Sam Gardiner, Daniel B. Fox and Nicholas K. J. Witney, "Theater Analysis and Modeling in an Era of Uncertainty: The Present and Future of Warfare," (Santa Monica, CA: Rand, 1994), 39-40.

45. Ellertson and Huffman, 50.

46. Owens, 17.

47. Sullivan and Dubik, "War in the Information Age,", 14.

BIBLIOGRAPHY

Alexander, David "Information Warfare and the Digitized Battlefield" Military Technology, (September 1995) 57-64.

Alexander, Bevin The Future of Warfare. New York/London: W.W. Norton and Co., 1995.

Barnaby, Frank The Automated Battlefield. New York: The Free Press, 1986.

Bellamy, Chris The Future of Land Warfare. New York: St. Martins Press, 1987.

Cordtz, Dan "War in the 21st Century: The Digitized Battlefield" Financial World (August 29, 1995) 48.

Dick, C.J. Russian Views on Future War, Conflict Studies Research Centre, The Royal Military Academy, Sandhurst, June 1993.

Ellertson, Jack W. LTC, USA and Lt Col Alan K. Huffman, USAF "Joint Precision Interdiction in the Post-CFE Environment." Military Review, (July 1991): 45-54

Garretson, Jeremiah F. "Confronting Challenges to Jointness: Initiatives for Joint Command and Control," Defence Technical Information Center, (1993).

Gray, Colin S. "The Changing Nature of Warfare?" The Officer, (August 1995) 36-39.

Gunther, Judith, Suzanne Kantra, Robert Langreth "Digital Warrior" Popular Science, (September 1994) 60-64/89.

Harkavy, Robert E., and Stephanie G. Neuman. The Lessons of Recent Wars in the Third World, Volume I. Lexington, Massachusetts: Lexington Books, 1985.

Laur, Timothy M. Colonel and Steven L. Llanso Encyclopedia of Modern U.S. Military Weapons, New York: Berkley Books, 1995.

Lloyd, Charles D. Joint Stars: Concept to Desert Storm Deployment.

Mazarr, Michael J. The Revolution in Military Affairs: A Framework for Defense Planning, Strategic Studies Institute, U.S. Army War College, Carlisle Barracks, PA, 1994.

Mazarr, Michael J. The Military Technical Revolution, Center for Strategic and International Studies, Washington D.C., 1993.

Metz, Steven and James Kievit Strategy and the Revolution in Military Affairs: From Theory to Policy, Strategic Studies Institute, U.S. Army War College, Carlisle Barracks, PA, 1995.

Morrocco, John D. "U.S. Military Eyes Revolutionary Change" Aviation Week and Space Technology, (May 1, 1995).

Oder, Joseph E. Brig General, USA "Digitizing the Battlefield: The Army's First Step to Force XXI," Army, (May 1994).

Owens, William A. Admiral, USN. "The Emerging System of Systems," Military Review, (May-June 1995)

Roland, Alex, The Technological Fix: Weapons and the Cost of War, Strategic Studies Institute, U.S. Army War College, Carlisle Barracks, PA, April 1995.

Sullivan, Gordon R. General, USA, and LTC Anthony M. Coroalles, USA, The Army in the Information Age. Strategic Studies Institute, U.S. Army War College, Carlisle Barracks, PA, March 1995.

Sullivan, Gordon R. General, USA, and LTC James M. Dubik, USA, Land Warfare in the 21st Century, Strategic Studies Institute, U.S. Army War College, Carlisle Barracks, PA, February 1993.

Sullivan, Gordon R. General, USA, and LTC James M. Dubik, USA, War in the Information Age, Strategic Studies Institute, U.S. Army War College, Carlisle Barracks, PA, 1994.

"The Information Age" The Economist, (June 10, 1995) 5-7.

Toffler, Alvin and Heidi. War and Antiwar. Boston: Little, Brown and Co., 1993.

"U.S. Air Force Almanac 1995." Air Force Magazine (May 1995).

U.S. Department of the Army. Battle Labs. . . Defining the Future. Fort Monroe, VA: U.S. Department of the Army, May 1995.

U.S. Department of the Army. Field Manual (FM) 100-5 Operations. Washington: Department of the Army, 14 June 1993.

U.S. Department of the Army. Field Manual (FM) 100-7 Decisive Force: The Army in Theater Operations. Washington: Department of the Army, 31 May 1995.

U.S. Department of the Army. Looking to the Future: TRADOCS 20th Anniversary Seminar on Future Warfare. Fort Monroe, VA: U.S. Department of the Army, July 1993.

U.S. Department of the Army. TRADOC Pamphlet 525-5. Fort Monroe, VA: U.S. Department of the Army, 1 August 1994.

U.S. Department of Defense. Doctrine for Joint Operations, Joint Pub 3-0. Washington D.C.: U.S. Department of Defense, 1 February 1995.

U.S. Department of Defense Office of the Joint Chiefs of Staff. C4I for the Warrior. Washington D.C.: U.S. Department of Defense, 12 June 1992.